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## LOCAL FRUITS AND NUTS AS A TOOL FOR THE DEVELOPMENT OF AFGHANISTAN

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### ABSTRACT

The Perennial Horticulture Development Project – Afghanistan ([www.afghanistanhorticulture.org](http://www.afghanistanhorticulture.org)) funded by the EC-EuropeAid Program since 2006, is supporting the Ministry of Agriculture, Irrigation and Livestock of Afghanistan in the sector of fruit culture, including the fruit tree nursery segment, through a process of collection and selection of local fruit varieties. The main goals are the strengthening of the perennial horticulture through the utilisation of mostly local and imported genetic resources and the development of a consistent private commercial nursery sector. About a thousand fruit varieties (of grape, almond, pomegranate, apricot, etc.), selected by local advisors across a wide area of Afghanistan were collected during the first phase of the project (2006-2010), propagated and planted in National Collections at six Perennial Horticulture Development Centres. The collected accessions are under morphological characterization and evaluation following standardized methods in order to choose the best ones and to allow their registration in a national list, hence contributing to their safeguard and protection. Many varieties are already being cultivated and are also being used for adaptive research in order to point out the best cultural practices (e.g. pruning, training). PHDP also provides capacity building at technical and institutional level, fosters the establishment of nursery sector associations and helps to provide international expertise for local staff in cooperation with local and foreign universities, and NGOs and other public and private companies working in Afghanistan are also involved. One of the most challenging tasks is to promote, tutor and bring to sustainability the Afghanistan National Nursery Growers Organization (ANNGO) and the apex Afghanistan National Horticulture Development Organization (ANHDO), mainly concerned with value chains.

### FOREWORD

This paper aims at illustrating the activities of the Perennial Horticulture Development Project (PHDP) and placing them within the framework of the economic development of Afghanistan. The description of the project and the related considerations will be performed by keeping in mind the leading question of the Section "Rural development, natural resources and environment - 3.2 Agro-biodiversity and diversified agro-husbandry systems" of this Congress, which states "the integration between scientific and technological innovation and traditional knowledge and use of local genetic resources: how to promote capacity building and technological transfer taking into account these aspects?".

### INSIGHT AFGHANISTAN

This section briefly describes the country's background and those aspects directly related to the PHDP activities, focused as they are on the development of fruit culture sector.

#### Historical, cultural and institutional background

The 5,000 year history of Afghanistan can be defined as a continuous overlapping of conquests and defeats by neighbouring countries and civilizations which have lead to a variegated and multiethnic nation. The current conflicts go back to 34 years, and have deeply affected people and their relationships both within and between ethnic groups. Even if the war had tragic effects in the countryside, the rural cultural heritage and social structure could stand these events better than towns, where, most of the governmental structures (e.g. Ministry of Agriculture and Universities) practically collapsed, leaving a void in the institutions demanded to manage and promote, for instance, agriculture, the leading sector of the economy of Afghanistan. The destruction of buildings was closely accompanied by the almost total annihilation of human resources, with a whole generation of people missing out on education and social and economic development. Another effect of the conflicts was, notwithstanding the wide *diaspora* of Afghan citizens, the isolation of this country towards the international community in most of sectors of public and private activities. Hence material rehabilitation and human capacity building are still a must in Afghanistan.

## Environment and agriculture

Afghanistan has a surface of 652,230 km<sup>2</sup>, two thirds of which are represented by mountainous terrain and dry plains with little or no vegetation. Good statistics are impossible to come by, but of the total 65 million ha only 12% is ever cultivated, as most of the land is too mountainous to cultivate, and much of the rest of the land receives too little rainfall for rainfed crops. Of this approximately 8 million ha of cultivated land, only about 2 million ha is irrigable currently; although many irrigation schemes could be improved or extended. Water for irrigation is generally derived from precipitation as snow at high altitude in the winter. Where water courses are fed directly from melting snow, the irrigation capacity decreases during the summer as snow melts. More consistent aquifers are available from groundwater areas, and a limited number of dams were built going back as far as the 1950s. High mountain chains (e.g. the Hindu Kush) separate usually narrow valleys with specific microclimates, each one with diverse typical fruit varieties. In the central and northern parts of the country, the climate is harsh, with very cold winters and very hot, dry and in many areas windy summers. Nevertheless a wide range of temperate species are adapted to these conditions and are grown from 250 m up to 2-3,000 m above sea level. In southern areas, winters are milder, and in parts of eastern Afghanistan, which are on the edge of the areas influenced by the South Asian monsoon system, many citrus and similarly tender species can be grown. Over 75% of the Afghan people live in rural areas where agriculture is the primary activity and the agriculture sector contributes about half of the GDP of the country. The World Bank estimates that to enable faster economic growth and rural poverty reduction, agriculture needs to grow at least 5% per year over the next decade. This is a big challenge since technology, communication and transport, irrigation, and education are substantially deteriorated due to conflicts and lack of maintenance. Both public and private institutions lack the physical infrastructure, the necessary regulatory framework, and the skilled staff to build a modern and competitive agricultural sector.

## Fruitculture

The strategic position of Afghanistan in the crossroad between western and eastern regions, which motivated the repeated conquests and re-conquests of that country by different civilizations, explains the presence and the wide diversification of most of temperate fruits species originated in Middle East, Central and Eastern Asia. Many historical and artistic records indicate a strong traditional linkage between the Afghan people and fruits (fresh and dried fruits, and nuts) [1]. For instance, Qasem Ebne Yousof Abunasre Herawi, in his "Guide to agriculture" of the XIV Century, quoted over 100 types of grapes for the area of Herat. Fruits trees are very often recalled in present literature; some nice examples related to pomegranate and pistachio trees can be found in the popular "The Kite Runner" [2] and "A Thousand Splendid Suns" [3] novels of Khaled Hosseini, while "I fichi rossi di Mazar" (*The Red Figs of Mazar*) is the title of a recent book by Mohammad Hussain Mohammadi [4]. An interesting Italian reference, where fruit trees are cited, is "Nel mare ci sono i coccodrilli – Storia vera di Enataiatollah Akbari" (*In the Sea There Are Crocodiles*) by Fabio Geda [5], based on the candid testament of the experiences faced by a young asylum-seeker from Nava (Afghanistan). These are sound proofs of how much fruits are a part of Afghans everyday life and how deeply they are linked to their cultural heritage. The "bagh" is the typically closed home garden where a wide range of species and varieties (often obtained directly by seed) are grown and from which many local varieties, composing the fruit germplasm of Afghanistan, came out. More specialized mono-specific orchards are also called *baghs* and they supply most of fruits and nuts, nevertheless also sparse trees in community areas are a valuable source of some nuts like pistachios and seldom "wild" pomegranates. Afghan consumers prefer very sweet, extremely low acidic and tasty fruits; high sugar content is a necessary condition for drying fruits, a very popular and traditional practice in Afghanistan, which is facilitated by very hot and very dry air during windy summer times. As a matter of fact, storing dried fruits and nuts represents a suitable strategy to overcome harsh winters with a natural and healthy source of energy in the rural areas. Fruits represent for the Afghan population a valuable product both for subsistence and profit. Fruit and nut production in 2011 reached 1,355,985 t [6]; the actual amount could be more, since the statistics on production are not always very reliable. The percentage of "fruit and nut production on total crop production" in Afghanistan is over 16%, which is quite high if compared to world average (about 11%), and lower than the proportion of Italy (about 30%), considered a typical fruit producing country. The following table 1 gives a picture of the species cultivated in Afghanistan and their relevance in the sector. Global fruit production yield in Afghanistan (6,7 t/ha) is about half of the Italian value; the most unbalanced situations are presented by apple production (the Afghan yield is about 15% of the Italian one) and then by peaches and nectarines (38%) and apricots (50%). These figures are evidencing problems in terms of fertility, production systems and cultural practices. Insofar as these yield figures are reliable, they are also influenced by the average age of the orchards, after a lot of orchard planting in the last few years. One aspect of major concern for fruit industry in many developing countries is related to the nursery system, the starting segment of fruit production chain. A strong impulse to top quality fruit production in developed countries of the last decades was the adoption of high quality propagation material, characterized by true-to-type genetic identity, clean phytosanitary status and high technological properties. Traceable propagation material (such as buds, cuttings and saplings) released by a nursery sector working under a certification-filiation scheme is a guarantee of quality for fruit growers. At this regards Figure 1 clearly illustrates the potential effect of the application of a nursery system based on traceability on the orchards of Afghanistan, characterised by poor quality, mixed and often un-identified trees. The limited natural

resources and the high population growth rate (average of 3,2%, against 1,2% of world in the last ten years) of Afghanistan, impose to adopt innovative strategies in agriculture (and namely in fruit culture) in order to increase yields in general terms, and, at the same time, to improve the marketability of fresh and dried fruits, and nuts. At this regard, it is worth to notice that Afghanistan is a net exporter of grape and raisins ( $\approx 48,000$  t in total), pomegranates ( $\approx 50,000$  t), fresh and dried apricots ( $\approx 8,000$  t in total), then dried fig, pistachios, etc. (FAOSTAT, 2013; Saeedi *et al.*, 2011), while is a relatively strong importer of citrus ( $\approx 120,000$  t). Increasing and improving production will answer to country's growing demand of fruits, will promote export and reduce import.

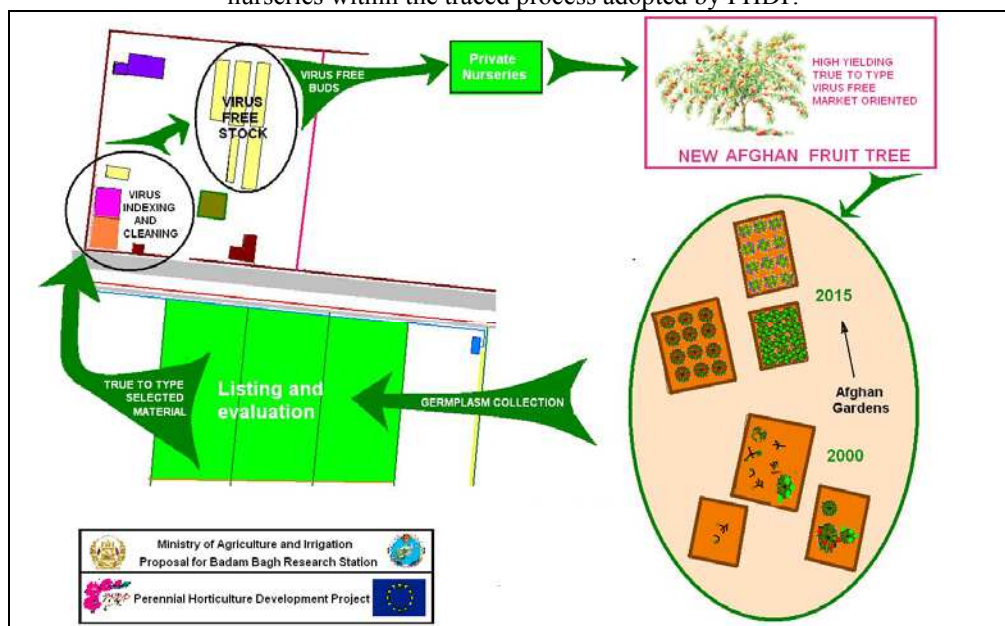
### Science, technology and institutions

Each important town of Afghanistan has a university with a Faculty of Agriculture; the authors of this paper have direct contacts with the Faculties of Agriculture of Kabul, Herat, Nangarhar Kunduz and Mazar Universities. Unfortunately the universities greatly suffered the effects of conflicts, the organisation, content and quality of the courses are still far away from the international standards. The causes of this disparity are essentially the lack of financial support (also for physical re-building and payments of salaries) and, with some outstanding exceptions, a generalized very poor human capacity. As a consequence the development of basic and applied knowledge and technology is very poor. Universities in Afghanistan are not considered to have any research function. Similarly, public institutions devoted to manage, promote and develop agriculture (and namely perennial horticulture) need to be supported in order to foster their concrete and active rehabilitation and assume the role they are expected to have in society. As a matter of fact, the few regulations existing for agriculture (namely fruit culture) are not applied following standardised procedures and "certificates" are in many cases almost merely bureaucratic documents.

**Tab. 1** - Fruit production of Afghanistan in 2011 (FAOSTAT, 2013; other sources).

Species	Amount (t)	Amount (%)	Species	Amount (t)	Amount (%)
Pomegranates	500000	36,9	Peaches and nectarines	13460	1,0
Grapes	411000	30,3	Oranges	7407	0,5
Almonds, with shell	60611	4,5	Pistachios (wild)	4203	0,3
Apples	59469	4,4	Pears	1596	0,1
Apricots	56043	4,1	Olives	1500	0,1
Plums and sloes	28406	2,1	Other fresh fruits	106946	7,9
Berries	24604	1,8	Other stone fruits	44713	3,3
Figs	19045	1,4	Other nuts	1649	0,1
Walnuts, with shell	13902	1,0	Other citrus	1431	0,1

**Fig. 1** – From the traditional orchards of 2000 to the specialized orchards of 2015 established with saplings released by nurseries within the traced process adopted by PHDP.



## THE PERENNIAL HORTICULTURE DEVELOPMENT PROJECT (PHDP)

### Origin

In the 1990s, after the fall of the Soviet supported government in 1992, various projects supported the development of fruit tree nurseries and the introduction of many modern varieties of peach, plum, apple, almond, apricot, as well as rootstocks for apples. A leading figure in these efforts was Dr Abdul Wakil, one time Minister of Agriculture in the time of Zahir Shah, who led in the training of a large number of personnel in the basics of budding, grafting, orchard management and related skills. These trained people, mostly aged in their 50s by the time of the start of PHDP, were available to PHDP to staff the project and the NGO sub-projects. Other younger staff who had grown up and trained in Pakistan were also recruited.

The efforts included setting up mother stock nurseries and propagation of fruit trees at government research stations, which were managed by various NGOs for this purpose. This original concept of a limited number of key mother stock nurseries run on Ministry land informed the design of projects such as PHDP and also the World Bank (Emergency) Horticulture and Livestock Project (HLP), both starting in 2006.

Another initiative undertaken by PHDP that had never been done before, was the description of germplasm. Physical collection of Afghan fruit germplasm was first done by PHDP from 2007. Some fruit germplasm collection done by FAO and ICARDA prior to 2006 was lost due to lack of records and lack of continuity in activities. A major centre of the germplasm description was in Ghazni, which has still not been accessed by the PHDP, due to security problems. This earlier work on germplasm description provided the PHDP with the possibility of recruiting one or other of the two persons with some experience in this work.

The FAO received a grant from Italian Cooperation for the restoration of the Afghan germplasm in 2002-2003. The project imported a range of apple, plum, peach-almond, quince (for pear), cherry rootstocks. These were planted in Kabul, Ghazni and Herat. By 2006, at the start of PHDP, the Ghazni materials were inaccessible, and the Kabul materials were denied to the project by the Head of Research at MAIL ("PHDP should bring in its own materials").

Following the funding of the FAO project by Italian Cooperation, the FAO staff approached the European Commission in regard to follow-on funding. The European Commission Delegation organised a feasibility study in 2004 focused on the development of the Ministry of Agriculture, restoration of the old mother stock nursery systems, with six nuclear stock nurseries, and some germplasm collection.

A report prepared during 2004 in Kabul identified the main subjects taken up by PHDP when it commenced in 2006. These main subjects included: a) *germplasm collection and nursery development*; b) *clean germplasm systems*; c) *provision of facilities for the development and testing of new varieties of and new growing systems of horticultural crops*; d) *training programmes for implementing agencies; training for senior extensionists/MAIL staff/farmers/traders; linkages between MAIL and universities*; e) *development of an integrated horticultural research and technology transfer system*.

During 2005, taking into account the Agriculture Master Plan [7], the objectives of PHDP were clearly defined in the overall scheme of a number of horticultural development projects. Basically, the actual design of the EC horticultural project was adapted to minimise the direct involvement of the MAIL in the production of fruit trees and in the development of mother nurseries, with the MAIL emphasizing to the maintenance of reference collections, research and extension production methods and regulation of the industry, backed up by appropriate analytical laboratories and an inspection and quarantine system.

### Management and main objectives

In 2006 the European Commission-EuropeAid Program funded through a public/private consortium formed by IAK Agrar Consulting GmbH, AHT GmbH and the University of Florence-Italy the Perennial Horticulture Development Project (PHDP) ([www.afghanhorticulture.org](http://www.afghanhorticulture.org)) in support to the Ministry of Agriculture, Irrigation and Livestock of Afghanistan (MAIL). A second phase is being supported by EC for the period 2010-2015 to a wider consortium (Agriconsulting SpA, Department of Agri-food and Environmental Science - University of Florence, Department of Agricultural Sciences - University of Bologna, Centro Attività Vivaistiche, Landell Mills UK) with the contract "Technical assistance to MAIL to strengthen the planting material and horticulture industry in Afghanistan (EuropeAid/129-320/C/SER/AF/2)". PHDP involved as an average four international permanent staff, ten short terms experts, and forty local staff, for about 150 man/months international and 630 man/months local staff. As stated in the project web pages "The specific objective of the project is to develop a demand oriented and export led perennial horticulture industry". A major purpose of the project is to develop the nursery sector of this country in order to strengthen and to qualify fruit production. The main activities regard the establishment of a traced nursery system based on the propagation of true-to-type local varieties. The adopted steps can be summarized as follows: i) individuation of superior trees in productive orchards; ii) cataloguing and definition of the *in situ* National Collection; iii) propagation from the *in situ* original mother plants; iv) establishment of the *ex situ* National Collection; v) characterisation and evaluation; vi) foundation of traced mother stock nurseries (MSN). Such activity included also the establishment of six centres (the main one located at Badam Bagh - Kabul, the remainder in Herat, Jalalabad, Kandahar, Kunduz and Mazar-e-Sharif) and of a Laboratory of Biotechnology for plant indexing and micropropagation. PHDP workplan can be



distinguished into the following five components: 1. public and private sector institutional and regulatory reform; 2. national collection of fruit varieties and adaptive research; 3. nursery industry; 4. training and extension; 5. horizontal activities.

The concept underlying all the activities can be summarized with the call for a meeting with local nurseries and fruit-growers: *It is the intention of the PHDP to undertake various initiatives that create and develop a system that ensures the availability of the best possible planting material for the perennial horticulture industry in Afghanistan, and to ensure the long term sustainability of such a system owned by the private sector.*

Long term sustainability regards essentially the handover of the system built up by PHDP to the local staff of MAIL and of two organizations, the "Afghan National Horticulture Development Organization" (ANHDO) and the "Afghan National Nursery Growers Organization" (ANNGO) currently under temporary tutorship/supervision of international experts.

## PHDP: MAIN RESULTS

PHDP has a quite long history; along the last 7 years relevant achievements were mixed to organizational problems in some cases due to safety issues, which threaten the positive development of specific tasks. The authors are describing here only some of the results more directly linked to the problematic backgrounds highlighted in the previous chapters.

### The National Collection of Fruits and Nuts of Afghanistan

After the field surveys performed during 2006-2008, an *in situ* collection of over 850 accessions of different fruit species, selected by local staff with the participation of farmers holding the trees, was defined. The best and more "profitable" varieties were chosen together with fruit growers (who were recognized as "custodial" of the *in situ* selected accessions) to be propagated and planted in the 6 PHDP Centers in plots with mostly six replicates in the *ex situ* collections, which form the National Collection (NC). For each species, for security reasons, the NCs have been duplicated. The amount and location of collected accessions is reported in table 2. Most of the accessions were locally collected, with the exceptions of citrus, loquat and persimmon, donated by CRA-Centro di ricerca per l'agricoltura e le colture mediterranee - Acireale (Italy) and IVIA-Valencia (Spain), for which most of accessions have been imported since they were considered strategic for the development of fruit-growing especially in the area of Nangarhar valley (Jalalabad Province). Many varieties of cherry, peach, plum, apple and pear represent introductions in the last twenty years, or even more recently. Most apricots and almonds are of native varieties, and represent a valuable genetic resource not available elsewhere. Many grape and pomegranate varieties were also collected locally, but they are probably well represented in germplasm collections elsewhere, and many foreign varieties look to have more potential at first glance, due to lack of development of these species in Afghanistan. The NC represents the source of material to establish the Mother Stock Nurseries (MSNs) in different parts of the country. In 2009 the characterisation of accessions following standardized procedures (specific descriptor lists for each species) started and up to now around 70% of all collectable data have been gathered and input in a database by trained local staff. At present the description is going to completion and identification procedures started where necessary. Once this task will be finished, possibly also with the support of DNA fingerprinting, all the accessions will be registered by the MAIL of Afghanistan. The management and conservation of the NC will be in the hands of ANHDO (see next paragraph).

**Tab. 2 -** Amount of accessions in the National Collection of Fruits and Nuts of Afghanistan in the PHDP Centres.

Species	Kabul PHDP Centre	Kunduz PHDP Centre	Mazar PHDP Centre	Herat PHDP Centre	Kandahar PHDP Centre	Jalalabad PHDP Centre
Almond		98	100			
Apricot	125		118			
Cherry	26			28		
Peach				102	84	
Plum				77	75	
Apple	78	51				
Pear	42	50				
Grape				139	138	
Pomegranate					54	79
Fig					12	16
Loquat						12
Date Palm						6
Citrus						61
Total	271	199	218	346	363	101

### The apricots of Afghanistan

A huge amount of different types has been gathered for each species. We report here some information on apricot, chosen as a representative case. Apricot varieties in Afghanistan are generally white fleshed (occasionally orange fleshed), generally sweet, with little or no acidity, frequently without "apricot" flavour (compared to Turkish or European/American types), but often with aromatic flavours like coconut, generally with non-bitter kernels, and generally self incompatible. The apricot types include the large fruited white fleshed types called Amiri, which are grown at higher altitudes, 2000 m +, are slow to come into bearing, and are represented by a small number of closely related varieties. PHDP has identified 15 Amiri accessions, which are similar in fruit and tree characters, and may represent many fewer varieties. The Amiri fruit is sweet, without apricot "taste", and can be dried to a pale golden colour with sulphuring. The dried fruit fetches high prices in Pakistan. The Amiri types replace all other apricots in the market once they start coming to the market. There are no early ripening Amiri varieties. Afghanistan also has several Shakarpara (meaning "a lot of sugar") types which are varieties where the small fruit is left to dry on the tree. There is no typical Shakarpara type tree among the many accessions in the PHDP collection. A third clearly identifiable type is the Saqi type, generally grown from seed only in the Bamyan province, and grown as large trees in pasture land. The fruit is used particularly for "chapanemak", where the seed is removed, and the apricot flesh is turned inside out before drying. The fruit are prepared and dried at home. The fruit is bright orange. The project collected four accessions from village trees to assess a best clone for multiplying by budding and grafting. Many other apricot varieties are available, but the names of accessions often refer to place of origin and relationships between varieties remain to be sorted.

### The Laboratory of Biotechnology

A good example of capacity building is represented by the Laboratory of Biotechnology and its staff. During 2008, under the umbrella of PHDP, Aga Khan Foundation managed the project "Establishing Disease Indexing Services in Afghanistan". The aim was to train the staff in Italy by the University of Florence, Bologna and by CAV, and to establish in Kabul a laboratory enabled to check the phytosanitary status of propagation material (namely the accessions of the NC and of Mother Stock Nurseries). Once built up the laboratory, the first step was to apply the standardized procedures to detect virus like diseases by ELISA tests, following the European Plant Protection Office standards. In time, some additional tasks were endorsed to this Laboratory (PCR based detection of disease and *in vitro* micropropagation). Among the most relevant results of such activity, it was assessed that no one of the accessions belonging to *Prunus* spp. resulted infected by Plum Pox Virus and that most of the material could be considered clean. This finding was useful to alert PHDP and MAIL, and indirectly all the international and local organisations importing plant material, in order to be accepted from abroad only virus tested certified propagation material. A special situation was afforded with citrus orchards, where Citrus Tristeza Virus was detected; these results were presented to the 22<sup>nd</sup> "International Conference on Virus and Other Transmissible Diseases of Fruit Crops" (Rome, June 3-8, 2012) by the staff of the laboratory and a related note was published [8]. The Laboratory, unique of this kind in the area, is expected to perform phytosanitary and genetic analysis for public and private institutions. A similar record of internationalization is the participation of two field horticulturists to the II International Symposium on the Pomegranate (Madrid, 19-21 October 2011), presenting the status of Pomegranate industry and germplasm collection in Afghanistan [9].

### ANNGO and ANHDO

PHDP developed a widespread network of public and private, local and international actors (NGOs, associations, nurseries, etc.) working in the nursery sector and in fruit-growing. As a result, it "covered" almost all the areas of Afghanistan involved in fruit production. For instance, the Afghan National Nursery Growers Association (ANNGO), partner with MAIL, ANHDO, PHDP2 and other organizations, represents 27 Nursery Growers Associations in 22 provinces; all the nursery members (more than 1,000) have voluntarily accepted the ANNGO regulatory system for planting material, so ensuring that the saplings sold to the fruit growers are true-to-type and traceable to Mother Stock Nurseries (MSNs) originated from the National Collection. Such material is constantly checked by the Laboratory of Biotechnology of Kabul. Business improvement and marketing promotion; sanitary controls; monitoring the quality of planting material; improvement of nursery techniques, production of clonal rootstocks; certification and inspection services including labeling of certified saplings; technical training and dissemination of innovations and publication of the catalogue of true-to-type saplings produced by NGA members, are the main services provided by ANNGO. In 2012/13 about 1.8 million of certified bud were sold to nurseries and 900.000 certified saplings were commercialized in Afghanistan and in neighboring countries. Figure 2 shows the distribution of MSNs and NGAs covered by ANNGO.

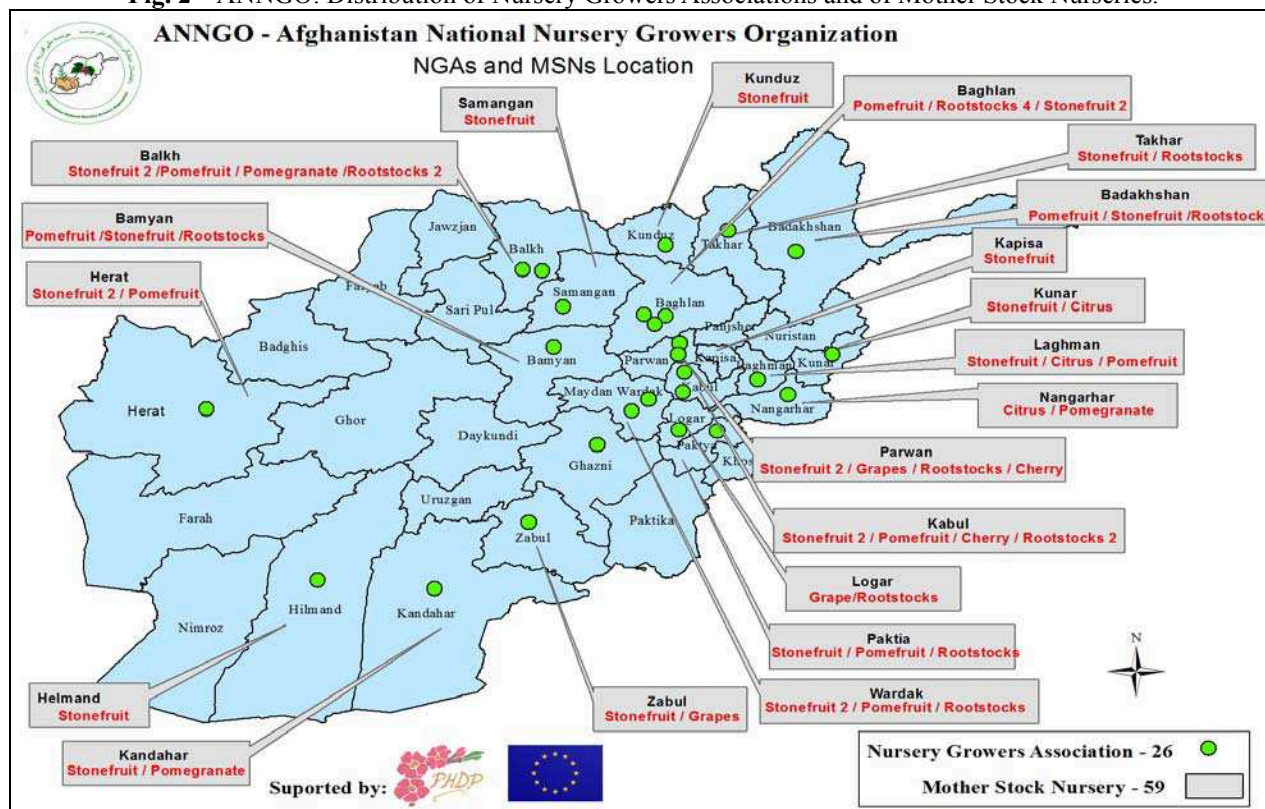
The other organization which is planned to give continuity to the activity done by PHDP I and II following the concept of sustainability, is the Afghanistan National Horticulture Development Organization (ANHDO), actually an NGO devoted to the development of a modern and sustainable horticulture in partnership with MAIL and private sector. ANHDO offer technical services for studies and surveys, training and capacity building, germplasm conservation, adaptive research, value chain studies, post-harvest technology and marketing. ANHDO is taking over the management of the National Collection and the 6 PHDP Centers in the MAIL research farms (which include also demonstration orchards, pomology laboratories and training rooms). ANHDO, with a grant from EC, is supporting the ongoing

transition of horticultural services from PHDP to MAIL.

## Adaptive research

The facilities provided by PHDPs (pomology laboratories in each PHDP Center, demonstration orchards, capacity) allowed to plan and develop various adaptive research activities, considered basilar to the improvement of productivity and quality of fruit growing. In Table 3 the list of the adaptive research lines is reported. The results of some of these investigations are already applied, for instance in the design of almond and apricot orchards for the choice of inter-compatible varieties, since many of the Afghan varieties resulted self-sterile. This information is diffused also through the Catalogue released by ANNGO.

**Fig. 2 – ANNGO: Distribution of Nursery Growers Associations and of Mother Stock Nurseries.**



**Tab. 3 - List of adaptive research lines launched by PHDPI and II and now being handed over to ANHDO.**

1. Description and evaluation of varieties
2. Assessment of genetic potential and selection of national almond genotypes
3. Assessment of compatibility of national almond clones
4. Use of Afghan and imported germplasm to develop improved varieties of almond
5. Assessment of self-compatibility of national apricot clones
6. Use of Afghan and foreign clones to develop improved varieties of apricots
7. Assessment of self-compatibility of national plum clones, including crossing with Myrobalan
8. Fruit processing – sulphur drying of apricots
9. Monitoring of *Psilla pyri* on pear clones
10. Plant protection against pest
11. Soil management and quality of fruits
12. Grafting compatibility of pears clones

The adaptive research “Use of Afghan and imported germplasm to develop improved varieties of almond” is a clear and simple model of innovation applied to actual local resources. Most of local Afghan varieties of almond are very early flowering (a negative trait because of recurrent frost damage), paper shell (a good commercial characteristic in terms of kernel/shell ratio and de-shelling), typical in kernel shape (crescent type) and very appreciated for their taste. Indeed these are the most outstanding characteristics of the “Sattarbai” group, producing the most valued almonds in Afghanistan. The seeds resulted from the compatibility trials carried on with many local cultivars in 2008-2009 were planted and a first selection of F<sub>1</sub> seedlings was performed in 2012 by almond producers and retailers. The best F<sub>1</sub>



seedlings will be re-checked and possibly released as new cultivars in near future. An improvement of this participative "breeding" activity is related to perform crosses between local (bringing high quality fruit traits) and international varieties characterized by late flowers, a trait which allows to escape spring frosts; from this set of seedlings it is expected to obtain new high quality, Afghan type and late flowering cultivars.

## CONCLUSIVE CONSIDERATIONS

The pillars on which PHDP is founded cover a wide spectrum of activities, in accordance with the priorities acknowledged for the development of Afghan agriculture [10], related essentially the application of an innovative traceable propagation system to the local fruit germplasm, which is a relevant component of agrobiodiversity in Afghanistan. Fruit genetic resources are, furthermore, an actual and potential tool for the fair development of fruitculture, a strategic sector for this country. The selection and rational utilization of local varieties (both for direct fruit production and for breeding), their conservation and registration as national genetic resources, represents a way to protect this material from illegal appropriation and genetic erosion, but also a means to develop capacity building in both institutional and private sectors, and to promote indirect activities. Looking forward, some relevant items of the new scenarios of Afghan fruit industry to be addressed are quality standards for domestic and international markets, food safety regulations namely to export dried fruits and nuts, post-harvest management of soft fruits (being transport facilities and cold chain key factors), institutional support to these activities. Notwithstanding the goals achieved by the project, its further development will still need the support of international donors. Nevertheless a strong base for sustainability has been posed on local organizations; this represents an important step beyond total dependency.

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## NOMENCLATURE

EC	European Commission
PHDP	Perennial Horticulture Development Project
MAIL	Ministry of Agriculture, Irrigation and Livestock - Afghanistan
NC	National Collection
ANNGO	Afghanistan National Nursery Growers Organization
ANDHO	Afghanistan National Horticulture Development Organization
NGA	Nursery Growers Associations
MSN	Mother Stock Nursery

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